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Set Name side by side	**Query**	**Hit Count**	**Set Name** result set
	DB=USPT,USOC; PLUR=YES; OP=OR		
L8	l3 or l7	23	L8
L7	(front same rear same (connector near5 hole)) and (backplane or (back adj1 plane))	22	L7
L6	L5	0	L6
L5	(front same rear same (connector near5 hole) same segment) and (backplane or (back adj1 plane))	0	L5
L4	(front same rear same (connector adj1 hole) same segment) and (backplane or (back adj1 plane))	0	L4
L3	(front same rear same connector same hole same segment) and (backplane or (back adj1 plane))	1	L3
L2	(front same rear same connector same hole) and (backplane or (back adj1 plane))	121	L2
L1	(front same rear same connector) and (backplane or (back adj1 plane))	609	L1

Refine Search

Search Results -

Terms	Documents
L8	0

Database:

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Search: L9

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DATE: Monday, August 30, 2004 Printable Copy Create Case

Set Name side by side	**Query**	**Hit Count**	**Set Name** result set
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L8	l3 or l7	23	L8
L7	(front same rear same (connector near5 hole)) and (backplane or (back adj1 plane))	22	L7
L6	L5	0	L6
L5	(front same rear same (connector near5 hole) same segment) and (backplane or (back adj1 plane))	0	L5
L4	(front same rear same (connector adj1 hole) same segment) and (backplane or (back adj1 plane))	0	L4
L3	(front same rear same connector same hole same segment) and (backplane or (back adj1 plane))	1	L3
L2	(front same rear same connector same hole) and (backplane or (back adj1	121	L2

	plane))		
L1	(front same rear same connector) and (backplane or (back adj1 plane))	609	L1

END OF SEARCH HISTORY

Refine Search

Search Results -

Terms	Documents
(439/78 |439/79 |439/445 |439/572 |716/15 |709/253 |340/825 |333/260 |326/62 |174/52.1 |361/724 |361/748 |361/803 |361/788 |361/760 |710/305 |710/300 |710/301 |710/302 |710/303 |710/313 |370/464).ccls.	10279

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Search: L2

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DATE: Tuesday, August 31, 2004 Printable Copy Create Case

Set Name side by side **Query**

DB=USPT,USOC; PLUR=YES; OP=OR

L2 710/305,300-303,313;439/78,79,445,572;326/62;340/825;370/464;716/15;174/52.1;361/724,748,803,788,760;

DB=DWPI; PLUR=YES; OP=OR

L1 710/305,300-303,313;439/78,79,445,572;326/62;340/825;370/464;716/15;174/52.1;361/724,748,803,788,760;

END OF SEARCH HISTORY

Refine Search

Search Results -

Terms	Documents
L2 and L3	22

Database:

US Pre-Grant Publication Full-Text Database
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Search: L4

Refine Search

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Search History

DATE: Tuesday, August 31, 2004 Printable Copy Create Case

Set Name side by side	**Query**
	DB=USPT,USOC; PLUR=YES; OP=OR
L4	l2 and L3
L3	(front same rear same connector same hole) and (backplane or (back adj1 plane))
L2	710/305,300-303,313;439/78,79,445,572;326/62;340/825;370/464;716/15;174/52.1;361/724,748,803,788,760;:
	DB=DWPI; PLUR=YES; OP=OR
L1	710/305,300-303,313;439/78,79,445,572;326/62;340/825;370/464;716/15;174/52.1;361/724,748,803,788,760;:

END OF SEARCH HISTORY

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- Drafts
- Pending
- Active
  - L1: (39) (front same rear
  - L2: (1) l1 and (backplane
  - L3: (902) (front same rear
  - L4: (21) l3 and (backplane
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DBs USPAT

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1	BRS	L1	39	(front same rear same (connector adj1 hole))	USPAT	2004/08/30 15:52			0
2	BRS	L2	1	l1 and (backplane or (back adj1 plane))	USPAT	2004/08/30 15:53			0
3	BRS	L3	902	(front same rear same (connector near5 hole))	USPAT	2004/08/30 15:53			0
4	BRS	L4	21	l3 and (backplane or (back adj1 plane))	USPAT	2004/08/30 15:53			0

Start Proxima SSO EAST - [Untitled1:...

EAST - [Untitled1:1]

File View Edit Tools Window Help

Drafts
Pending
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L1: (39) (front same rear
L2: (1) l1 and (backplane
L3: (902) (front same rear
L4: (21) l3 and (backplane
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Saved
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DBs USPAT

Plurals

Highlight all hit terms initially

Default operator: OR

l3 and (backplane or (back adj1 plane))

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	U	1	Document ID	Issue Date	Pages	Title	Current OR	Current XRef
1	☐	☐	US 6759598 B2	20040706	18	Power distribution backplane	174/261	174/250
2	☐	☐	US 6757177 B2	20040629	10	Stacked backplane assembly	361/788	361/790; 361/803
3	☐	☐	US 6654235 B2	20031125	15	Portable workstation computer	361/683	150/165; 206/320;
4	☐	☐	US 6544045 B1	20030408	9	Surface mounted right angle electrical connector	439/79	
5	☐	☐	US 6535397 B2	20030318	16	Interconnect structure for interconnecting electronic	361/788	333/260; 333/33;
6	☐	☐	US 6468108 B1	20021022	9	Electrical connector with improved board locks	439/567	439/572; 439/607
7	☐	☐	US 6351786 B1	20020226	26	VXI backplane system improvements and methods	710/303	710/300; 710/301
8	☐	☐	US 6091609 A	20000718	25	Electronic circuit card having transient-tolerant	361/794	307/43; 361/729;
9	☐	☐	US 6058019 A	20000502	24	Electronic circuit card assembly having confined	361/760	174/51; 312/223.1;
10	☐	☐	US 6036529 A	20000314	12	Connector assembly with cable guide	439/445	439/446; 439/447
11	☐	☐	US 6014319 A	20000111	24	Multi-part concurrently maintainable electronic	361/788	307/43; 361/729;

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front and rear and connector [Search]

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Results Key:
JNL = Journal or Magazine **CNF** = Conference **STD** = Standard

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1 **Face-Lock^{TM} optical fiber connector design and fabrication**
Sheem, S.; Zhang, F.; Allen, E.; Lu, S.; Low, S.;
Electronic Components and Technology Conference, 1997. Proceedings., 47th
21 May 1997
Pages:410 - 413

[Abstract] [PDF Full-Text (684 KB)] **IEEE CNF**

Face-Lock^{TM} optical fiber connector design and fabrication

Sheem, S. Zhang, F. Allen, E. Lu, S. Low, S.
Berkeley Opt. Co., Livermore, CA, USA ;

This paper appears in: **Electronic Components and Technology Conference, 1997. Proceedings., 47th**

Meeting Date: 05/18/1997 - 05/21/1997
Publication Date: 18-21 May 1997
Location: San Jose, CA USA
On page(s): 410 - 413
Reference Cited: 3
Number of Pages: 1294
Inspec Accession Number: 5709588

Abstract:
In order to reduce the part and labor cost of optical fiber **connectors**, desirably to a level close to that of coaxial cable **connectors**, photolithography and plastic molding technology are used in combination to create a novel structure in which through-holes for positioning optical fibers are micromachined from the **rear** side of a silicon wafer, while recesses and ridges are fabricated on the **front** side of the wafer for two-dimensional lateral alignment of the through-holes and the fibers

Print Format

Index Terms:
micromachining optical fibre couplers optical fibre fabrication photolithography plastic packaging Face-Lock fiber **connector** fiber **connector** fabrication micromachined through holes optical fiber **connector** design photolithography plastic molding technology recesses ridges two-dimensional lateral alignment

Documents that cite this document
There are no citing documents available in IEEE Xplore at this time.

Search Results [PDF FULL-TEXT 684 KB] DOWNLOAD CITATION

US006535397B2

(12) **United States Patent**
Clark et al.

(10) **Patent No.:** **US 6,535,397 B2**
(45) **Date of Patent:** **Mar. 18, 2003**

(54) **INTERCONNECT STRUCTURE FOR INTERCONNECTING ELECTRONIC MODULES**

(75) Inventors: **William Clark**, Palm Bay, FL (US); **Douglas Heckaman**, Indialantic, FL (US); **Edward Bajgrowicz**, Palm Bay, FL (US)

(73) Assignee: **Harris Corporation**, Melbourne, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 139 days.

(21) Appl. No.: **09/871,167**

(22) Filed: **May 31, 2001**

(65) **Prior Publication Data**

US 2002/0180554 A1 Dec. 5, 2002

(51) **Int. Cl.**^{7} **H05K 7/04**; H01P 1/04

(52) **U.S. Cl.** **361/788**; 361/802; 361/805; 361/808; 361/809; 361/796; 439/61; 439/378; 439/579; 333/33; 333/260

(58) **Field of Search** 361/683–686, 361/778, 788, 796, 797, 801, 802, 805, 807–810; 439/61, 63, 378, 579, 581; 333/1, 33, 260

(56) **References Cited**

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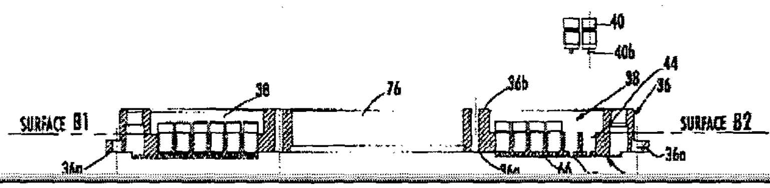
Primary Examiner—Albert W. Paladini
Assistant Examiner—John B Vigushin
(74) *Attorney, Agent, or Firm*—Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

An interconnect structure interconnects electronic modules and includes a backplane assembly formed from a substantially rigid backplane plate that carries RF connectors and a digital motherboard having digital connectors for mating with digital connectors of electronic modules. A controlled impedance interconnect circuit is positioned on the rear surface of the backplane plate and interconnects the RF connectors carried by the backplane plate and digital connectors of the digital motherboard. A rack receives the backplane assembly and supports a plurality of electronic modules that are interconnected to each other via the backplane assembly.

31 Claims, 8 Drawing Sheets



US-PAT-NO: 6468108

DOCUMENT-IDENTIFIER: US 6468108 B1

TITLE: Electrical connector with improved board locks

---------- KWIC ---------

Brief Summary Text - BSTX (5):

SCA-2 (single connector attachment) connectors provide a standard interface between SCSI (Small Computer System Interface) disk drives, Fiber Channel disk drives, GBIC (Gigabit Interface Converter) modules and back-plane systems. The SCA-2 connectors can be classified into three types, i.e., 20-pin, 40-pin and 80-pin SCA-2 connectors. The 20-pin SCA-2 connectors are used with GBIC modules used as media interface modules for fiber channel; the 40-pin SCA-2 connectors are used with 3.5" Fiber Channel disk drives; and the 80-pin SCA-2 connectors are used with 3.5" SCSI disk drives. A conventional SCA-2 connector comprises an insulative housing with a plurality of contacts received therein and a pair of board locks retained in the housing. Each board lock comprises a contact portion for engaging with a corresponding ground contact of a complementary SCA-2 connector, an intermediate portion perpendicularly extending from the contact portion, and a tail portion perpendicularly extending from the intermediate portion. The tail portion consists of a pair of legs for being inserted into corresponding through holes of a printed circuit board (PCB). Thus, the SCA-2 connector is mounted on the PCB via the board locks.

Detailed Description Text - DETX (10):

The board locks 4 are assembled to the housing 2 from the rear side too. The front contact portion 40 of the board lock 4 extends into the receiving channel 240 of the side arm 24 and projects beyond the mating section 22 of the housing 2; the fixed portion 42 is received in the chamber 205 and the barbs 420 of the fixed portion 42 engages with the base section 20 of the housing 2; the intermediate portion 44 is retained between the pair of protrusions 203; the tail portion 46 is fittingly retained in the cutout 260 of the projection 26 to restrict lateral movements thereof and the forwardly extending portion of the anchoring device 460 is received and retained in the channel 2602 of the projection 26 to prevent the tail portion 46 from warping upwardly; and the

EAST Browser - L4: (21) 3 and (backp... | US 6468108 | Tag: S | Doc: 6/21 | "Front Page" 1/1 (Total images 9)

File Edit View Tools Window Help

(12) **United States Patent**
Wu

(10) **Patent No.: US 6,468,108 B1**
(45) **Date of Patent: Oct. 22, 2002**

(54) **ELECTRICAL CONNECTOR WITH IMPROVED BOARD LOCKS**

(75) Inventor: **Jerry Wu**, Pan-Chiao (TW)

(73) Assignee: **Hon Hai Precision Ind. Co. Ltd.**, Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/912,850**

(22) Filed: **Jul. 24, 2001**

(51) **Int. Cl.**[7] **H01R 13/60**; H01R 13/66; H01R 13/73; H01R 1/01; H01R 13/648

(52) **U.S. Cl.** **439/567**; 439/572; 439/607

(58) **Field of Search** 439/567, 572, 439/357, 358, 607, 939, 352, 544, 555, 108

(56) **References Cited**

U.S. PATENT DOCUMENTS

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5,827,089 A * 10/1998 Beck, Jr. 439/567
6,287,146 B1 * 9/2001 Avery et al. 439/607

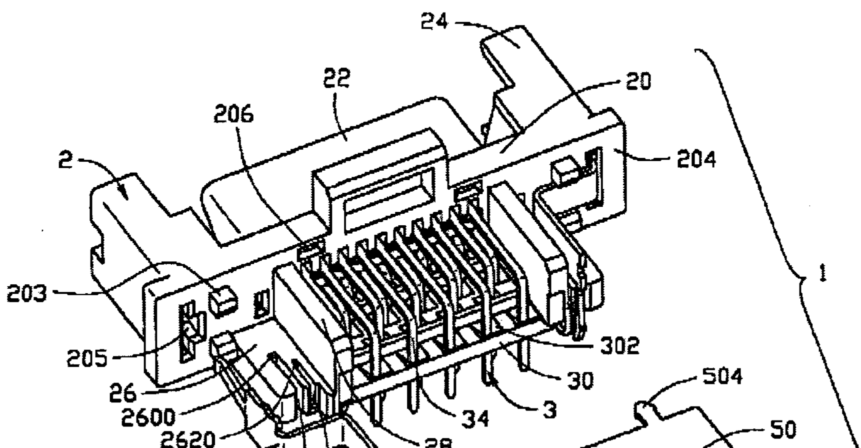
* cited by examiner

Primary Examiner—Khiem Nguyen
Assistant Examiner—Chandrika Prasad
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

An electrical connector (1) comprises an insulative housing (2) defining a number of passageways (220) with a number of contacts (3) received therein, a pair of rearwardly extending projections (26), and a pair of board locks (4) retained in the housing. Each projection defines a channel (2600) therein. Each board lock comprises a front contact portion (40) for contacting with a corresponding ground contact of a complementary connector, and a rear tail portion (46) for connection with a printed circuit board. The tail portion includes a L-shaped anchoring device (460) for being fittingly received and retained in the channel of a corresponding projection to prevent the tailportion of the board lock from warping upwardly, and a pair of legs (462) at a free end thereof for being inserted into corresponding through holes of the printed circuit board.

17 Claims, 5 Drawing Sheets



US-PAT-NO: 5557186

DOCUMENT-IDENTIFIER: US 5557186 A

TITLE: Linear accelerated device

---------- KWIC ---------

Detailed Description Text - DETX (5):

Each shelf 42 of bracket 40 receives three disc array chassis 70 side-by-side, as shown in detail in FIGS. 8a, 8b, 9a and 9b. The chassis 70 consists of a cage 72 having a backplane (circuit board) 74 mounted to its rear and a power board (circuit board) 76 piggybacked on the backplane 74. The cage 72, shown in FIGS. 8a and 8b consists of an open frame 78 having front flanges 79 with frame 78 divided in half vertically by an open partition 80. A top plate 82 is fixed to the top and a bottom plate 84 is fixed to the bottom. Both plates 82 and 84, at the front have flanges 86 for attaching the cages to the flanges at the edges of shelves 42 on their open side. The open frame 78 defines three sets of slides 88 in each half of the cage 72. The rear of cage 72 defines tabs or flanges 90 on which is mounted a back plane (circuit board) 74 and on which is mounted (piggybacked) a power board 76. Board 76 has mounted on its a pin connector 92 for bringing power to board 76 and a conventional DC module with cooling fins 93 to step down a large DC power voltage, e.g., 380 volts to 5 volt and 12 volt supplies for providing power to a disc drive. Centering pins can blank connector 92, to facilitate centering connector 92. Suitable electrical connections are provided (not shown) between board 76 and backplane 74. Backplane 74 is provided at the top and bottom with pairs of I/O connectors 100 provided with flanking threaded holes 102 for facilitating connection by suitable multi-pin I/O connectors to each half (divided vertically) of backplane 74. On each half are provided three vertically spaced multi-pin connectors 104. Holes 106 are provided for mounting board 76 via spacers 107.

Detailed Description Text - DETX (6):

Disc drives in sub-assemblies are slid into slides 88 and plugged into the connectors 104. To this end, a disc drive subassembly is shown in FIGS. 10a and 10b and consists of housing 110 made from a perforated top plate 112 having turned down lugs 114 at its rear and a depending front skirt 116, a bottom

US005557186A

United States Patent [19]

McMurtrey, Sr. et al.

[11] Patent Number: 5,557,186
[45] Date of Patent: Sep. 17, 1996

[54] LINEAR ACCELERATED DEVICE

[75] Inventors: Kevin D. McMurtrey, Sr., Ft. Lauderdale; Arthur M. Rossi, Hollywood; Robert J. Cichon, Jr., Plantation; Karen A. Briggs, Stuart; Jonathan C. Ely, Pompano Beach, all of Fla.

[73] Assignee: Encore Computer Corporation, Ft. Lauderdale, Fla.

[21] Appl. No.: 443,527

[22] Filed: May 18, 1995

Related U.S. Application Data

[63] Continuation of Ser. No. 252,996, Jun. 2, 1994, Pat. No. 5,469,037.

[51] Int. Cl.^{6} G11B 33/02; H05K 5/00

[52] U.S. Cl. 318/626; 312/223.2; 369/75.1; 364/708.1

[58] Field of Search 318/626, 652, 318/264, 265, 266, 286, 466, 467, 468; 364/708.1; 369/12, 75.1; 312/330.1, 223.1, 223.2

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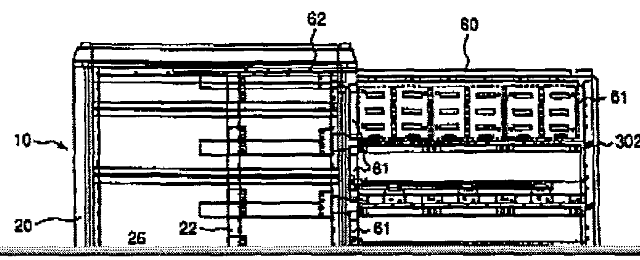
Primary Examiner—Bentsu Ro
Attorney, Agent, or Firm—Keck, Mahin & Cate

[57] ABSTRACT

High density disc drive apparatus that packs a large number of disc drives into a computer cabinet. The disc drives are removably installed in disc cages mounted on shelves of a drawer that slides out the front of the cabinet. A linear actuator drives the drawer and a controller moderates the actuator to ensure smooth start-up and stopping of the drawer so selected disc drives can be replaced during computer operation without disturbing the operation of the remaining disc drives. Built-in pin connectors facilitate bringing I/O and power cables to the disc drives and the desired replacement.

41 Claims, 17 Drawing Sheets



L8: Entry 6 of 23 File: USPT Oct 22, 2002

DOCUMENT-IDENTIFIER: US 6468108 B1
TITLE: Electrical connector with improved board locks

Brief Summary Text (5):
SCA-2 (single connector attachment) connectors provide a standard interface between SCSI (Small Computer System Interface) disk drives, Fiber Channel disk drives, GBIC (Gigabit Interface Converter) modules and back-plane systems. The SCA-2 connectors can be classified into three types, i.e., 20-pin, 40-pin and 80-pin SCA-2 connectors. The 20-pin SCA-2 connectors are used with GBIC modules used as media interface modules for fiber channel; the 40-pin SCA-2 connectors are used with 3.5" Fiber Channel disk drives; and the 80-pin SCA-2 connectors are used with 3.5" SCSI disk drives. A conventional SCA-2 connector comprises an insulative housing with a plurality of contacts received therein and a pair of board locks retained in the housing. Each board lock comprises a contact portion for engaging with a corresponding ground contact of a complementary SCA-2 connector, an intermediate portion perpendicularly extending from the contact portion, and a tail portion perpendicularly extending from the intermediate portion. The tail portion consists of a pair of legs for being inserted into corresponding through holes of a printed circuit board (PCB). Thus, the SCA-2 connector is mounted on the PCB via the board locks.

Detailed Description Text (10):
The board locks 4 are assembled to the housing 2 from the rear side too. The front contact portion 40 of the board lock 4 extends into the receiving channel 240 of the side arm 24 and projects beyond the mating section 22 of the housing 2; the fixed portion 42 is received in the chamber 205 and the barbs 420 of the fixed portion 42 engages with the base section 20 of the housing 2; the intermediate portion 44 is retained between the pair of protrusions 203; the tail portion 46 is fittingly retained in the cutout 260 of the projection 26 to restrict lateral movements thereof and the forwardly extending portion of the anchoring device 460 is received and retained in the channel 2602 of the projection 26 to prevent the tail portion 46 from warping upwardly; and the legs 462 of the tail portion 46 extends through the cutout 260 to be received in the corresponding through holes in the printed circuit board. Therefore, when the legs 462 of the board lock 4 of the SCA-2 connector 1 are inserted into the corresponding through holes in the printed circuit board, the board lock 4 will not warp upwardly and the SCA-2 connector can be stably retained on the printed circuit board to ensure a stability during a soldering process of the contacts 3, whereby a reliable electrical connection between the SCA-2 connector and the printed circuit board is ensured.

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L8: Entry 6 of 23 File: USPT Oct 22, 2002

US-PAT-NO: 6468108
DOCUMENT-IDENTIFIER: US 6468108 B1

TITLE: Electrical connector with improved board locks

DATE-ISSUED: October 22, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wu; Jerry	Pan-Chiao			TW

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Hon Hai Precision Ind. Co. Ltd.	Taipei Hsien			TW	03

APPL-NO: 09/ 912850 [PALM]
DATE FILED: July 24, 2001

INT-CL: [07] H01 R 13/60, H01 R 13/66, H01 R 13/73, H01 R 1/01, H01 R 13/648

US-CL-ISSUED: 439/567; 439/572, 439/607
US-CL-CURRENT: 439/567; 439/572, 439/607

FIELD-OF-SEARCH: 439/567, 439/572, 439/357, 439/358, 439/607, 439/939, 439/352, 439/544, 439/555, 439/108

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5094624	March 1992	Bakke et al.	439/326
5827089	October 1998	Beck, Jr.	439/567
6287146	September 2001	Avery et al.	439/607

ART-UNIT: 2839

PRIMARY-EXAMINER: Nguyen; Khiem

ASSISTANT-EXAMINER: Prasad; Chandrika

ATTY-AGENT-FIRM: Chung; Wei Te

ABSTRACT:

An electrical connector (1) comprises an insulative housing (2) defining a number of passageways (220) with a number of contacts (3) received therein, a pair of rearwardly extending projections (26), and a pair of board locks (4) retained in the housing. Each projection defines a channel (2600) therein. Each board lock comprises a front contact portion (40) for contacting with a corresponding ground contact of a complementary connector, and a rear tail portion (46) for connection with a printed circuit board. The tail portion includes a L-shaped anchoring device (460) for being fittingly received and retained in the channel of a corresponding projection to prevent the tailportion of the board lock from warping upwardly, and a pair of legs (462) at a free end thereof for being inserted into corresponding through holes of the printed circuit board.

17 Claims, 5 Drawing figures

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DOCUMENT-IDENTIFIER: US 6351786 B1
TITLE: VXI backplane system improvements and methods

Abstract Text (1):
A VXI product plug-in is provided herein that is capable of higher component density. The plug-in is configured to occupy two standard size slots of a standard VXI chassis, and includes two sets of three horizontally stacked modules in upper and lower sub-compartments of a front compartment of the plug-in carrier. The six modules have the capability of being populated with 480 switching relays, which provides for a 50 percent increase in the number of switches over the prior art plug-ins. The plug-in carrier includes a rear compartment that houses a VXI bus interfacing circuit, including a mezzanine board, a bridge board, and optionally a controller board, for interfacing the switch modules with a VXI backplane bus. The Plug-in further includes an internal backplane situated within the carrier between the front and rear compartments that provides an interface between the modules and the VXI bus interfacing circuit, and specifically, include a bus that can selectively couple modules together. Other aspects of the invention include an automatic updating scheme for updating the software installed on the controller card so that it has the necessary data and program code to operate new modules, an emergency reset mechanism for opening all relays pertinent to one module, and a mechanism for facilitating the insertion and removal of a VXI plug-in to and from a VXI chassis.

Brief Summary Text (2):
This invention relates to Versa-Module European (VME) Extensions for Instrumentation (VXI) based systems and products, and in particular, to an apparatus and method for configuring a VXI product plug-in to increase product component density, to an apparatus and method for facilitating the insertion and removal of VXI product carriers into and out of a standard VXI chassis, to an apparatus and method for facilitating the interfacing of new VXI products with a controller of VXI backplane systems, to an apparatus and method for providing an internal bus for selectively coupling VXI product modules, to a method and apparatus for providing an emergency reset mechanism to protect VXI product modules individually or together from potentially hazardous conditions, and to a method and apparatus for providing electromagnetic shielding between VXI product modules.

Brief Summary Text (4):
The VXI bus is a standard computer interface bus that originated in Europe, but has been widely accepted around the World. Its primary use has been in the testing and diagnostic field. For instance, it has been used for testing and troubleshooting of automobile components, medical devices such as pacemakers, computer-based systems, and microprocessor integrated circuits. Because of their testing and diagnostic capabilities, VXI bus systems typically comprise a plurality of switching modules. These switching modules connect to a unit-under-test (UUT) for testing and diagnostic purposes. A computer controller interfaces with the VXI backplane system to operate the switch modules in accordance with a testing and diagnostic strategy.

Brief Summary Text (5):
The VXI standard includes numerous specification requirements. These specifications

include, for example, chassis size and configuration requirements, power requirements, cooling requirements, backplane protocol requirements, and connector requirements, to name a few. Typically, designers of VXI products must adhere strictly to the required specifications of the VXI backplane system. Of particular interest to the invention is the VXI chassis slot configuration requirements.

Brief Summary Text (6):
FIG. 1 illustrates a simplified representation of the front face of a standard VXI chassis 100 of a VXI based system that is used in the prior art. The standard VXI chassis 100 includes a plurality of standard size slots 102 for respectively receiving therein VXI product plug-in 104 that connect to a VXI backplane bus situated at the back of the chassis (not shown in FIG. 1). FIG. 1 illustrates a representative sample of two (2) adjacent slots 102 for housing therein two adjacent VXI product plug-ins 104. A computer (not shown) can communicate with the VXI product plug-ins 104 by way of the VXI backplane bus through the use of a standard connector 106 located on an adapter module 107 typically positioned within the left-most slot of the chassis 100. The VXI product plug-ins 104 each include a housing 108 that is sized and dimensioned to slide into respective slots 102. A module card 110 is contained within each of the housings 108 for performing particular programmable functions. These modules may perform many types of operations, but for the purpose of this application, switch modules will serve to illustrate the invention.

Brief Summary Text (8):
FIG. 2 illustrates a block diagram of a prior art VXI based system 120 including a pair of VXI switching product plug-ins 130 and 132 positioned within respective VXI chassis slots (not shown in FIG. 2) and connected to a VXI backplane bus 142. The VXI switching plug-ins 130 and 132 include respective carrier housings 134 and 136 (represented by a dashed box) that houses respective pairs of switch cards 138 and 140. The switching cards 138 and 140 include respective connectors situated at the back side of the carriers in a manner that when the plug-ins are slid into corresponding slots of the VXI chassis, the connectors make operational contact with corresponding connectors on the VXI backplane bus 142. As it is typical of a VXI bus configuration, it includes lines for supplying power, lines for providing VXI signals, and non-designated lines for custom usage by a designer. The non-designated lines of a VXI backplane bus 142 are typically referred to as the local bus, and will be abbreviated herein as "LBUS."

Brief Summary Text (10):
At least one of the switch modules incorporated into the VXI based system 120 should include a controller circuit, such as controller circuit 144 present in switch module 138. The controller circuit receives the commands or VXI bus signals from the VXI backplane bus 142, and decodes these signals in order to issue address and data information for all of the modules connected to the LBUS. The address and data information issued by the controller 144 are directly applied to the switch module 138 card that incorporates the controller, or indirectly to the other modules, such as module 140, through the LBUS, which may be cascaded or daisy-chained as previously discussed. If all the modules are cascaded in the VXI based system, every module will receive the address and data information issued by the controller, and the addressed module or modules will respond accordingly.

Brief Summary Text (17):
Since a plurality of the modules, preferably six, are housed within compartments of the VXI plug-in carrier housing, there is a need to provide electromagnetic isolation between the modules to prevent interference or cross-talk between the modules. Accordingly, a thin sheet of electrically conducting material is provided between adjacent modules that preferably extends throughout the board length and height of the module. The thin conductive sheet is connected to a grounding plane on an internal backplane of the plug-in.

Brief Summary Text (18):
The rear compartment of the plug-in carrier in accordance with the invention houses a circuit for interfacing a VXI backplane bus with the modules occupying the front compartment of the carrier. Specifically, the interfacing circuit preferably comprises a mezzanine board, a bridge board, and optionally a controller board. More specifically, the mezzanine board interfaces with the VXI backplane bus to provide filtering of the VXI bus power lines and to provide these lines to the switch modules and the controller card. The controller card interfaces with the VXI backplane bus in order to decode or interpret data received from the VXI bus along the VXI signal lines, and to issue address and data information that are provided to the VXI modules along the local bus (LBUS) of the VXI backplane bus. The controller card has the capability of operating in a message based mode, using for example the IEEE 488.2 protocol or the Small Computer Programming Instruction (SCPI) protocol. In addition, the controller card has the capability of operating in a register based mode for increase throughput.

Brief Summary Text (19):
The bridge board interfaces with the VXI backplane bus to receive the address and data information issued by the controller card along the local bus (LBUS) of the VXI bus, and issues address, data and handshake signals for the six (6) VXI modules in data communication with the corresponding bridge card. A VXI based system need only have one plug-in that incorporates the controller card. The other plug-ins of the system can receive the addressing and operating instructions from the controller board by way of the local bus (LBUS), which can be configured in a daisy-chain manner for providing a connection between the controller card and potentially all the plug-ins sharing the VXI bus.

Brief Summary Text (20):
The VXI plug-in of the invention further includes an internal backplane bus that is preferably situated within the carrier between the front and rear compartments. It provides an interface between the mezzanine and bridge boards occupying the rear compartment, and the switch modules occupying the front compartment of the carrier. The internal backplane bus includes power busses that interface with the power lines of the mezzanine and bridge boards, and power lines of the switch modules. In addition, the internal backplane includes a programmable bus, referred to herein as the analog bus, configured in accordance with an aspect of the invention so that the six modules can be selectively coupled together in many combinations. In the preferred embodiment, the analog bus includes six module interfaces that are cascaded together by four independent differential signal busses. Each segment of the independent differential bus that couples adjacent module interfaces includes a series-connected relay switch housed by each of the six modules for selectively coupling the adjacent module interfaces. The relays can be set in a particular manner so that a desired connection is made between two or more selected modules.

Brief Summary Text (21):
Another aspect of the invention is to provide a mechanism for facilitating the insertion and removal of the VXI product plug-in card to and from the VXI chassis. This is accomplished by a pair of injection/ejection mechanisms that are pivotably coupled to the top and bottom of the carrier housing. The injection/ejection mechanism preferably includes a handle integrally attached to a pivot member having a bulb-shaped opening or hole centered at the pivot point and sized and dimensioned to receive a pin or the like to pivotably mount the mechanism to a carrier member. The pivot member includes an injection and ejection protrusion configured to contact a frame structure of the standard VXI chassis (designated herein as a "card guide rail") during the operation of the mechanism. During insertion of the plug-in into the VXI chassis, when the plug-in connectors make contact with the mating connectors of the VXI backplane, the injection/ejection mechanism is rotated so that the injection protrusion is forced against an injection lip on the card guide rail. This action essentially pulls the plug-in forward so that the connectors of the plug-in and the VXI backplane mate and are in a friction fit relationship.

During removal of the plug-in, the injection/ejection mechanism is rotated in an opposite manner so that the ejection protrusion is forced against an end of the card guide rail. This action essentially pushes the plug-in backwards so that the connectors of the plug-in and the VXI backplane are no longer in a mating and friction fit relationship.

Brief Summary Text (23):
Yet another aspect of the invention is to provide an emergency reset mechanism for a switching module that allows a user to open all the switching relays in the module by simply operating an externally provided switch. This is of value when a hazard condition exists that requires the user to quickly respond to a hazardous condition. The emergency reset mechanism can control the opening of the switches within a single module, without opening the switches in other modules or plug-ins. This allows for other test and diagnostic procedures to run on other modules, even though an emergency condition has occurred. The module also includes a jumper that when set, couples the emergency reset mechanism of one module to the other modules sharing the local bus (LBUS) of the VXI backplane bus to open all the switches on all modules.

Drawing Description Text (9):
FIG. 8a illustrates a block diagram of an internal backplane in accordance with an aspect of the invention;

Detailed Description Text (3):
A VXI product plug-in 205 comprises a carrier housing 206 that is sized and dimensioned to be received in slot 204. The carrier 206 preferably houses six (6) VXI module cards 208, whereby three (3) cards are positioned horizontally adjacent to each other at an upper section of the carrier, and the other three cards are positioned horizontally adjacent to each other at a lower section of the carrier. In this case, the carrier 206 houses modules that are situated adjacent to each other and relatively close. In the prior art VXI based system, adjacent modules 110 are separated by two carrier walls. Thus, there is substantial electromagnetic isolation between prior art modules 110. In order to provide electromagnetic isolation between adjacent modules 208 within carrier 206, thin sheets 210 of electrically conductive material are placed between adjacent modules and extend throughout the board length and width of the modules. The electrically-conductive thin sheets 210 are grounded by connection to a grounding plane located on an internal backplane (not shown), as will be explained in more detail later.

Detailed Description Text (5):
FIG. 4 illustrates a block diagram of a VXI product plug-in 250 configured to reside in the new VXI system 200 in accordance with another aspect of the invention. The VXI based system 200 comprises a VXI plug-in 250 comprising a carrier housing 252 that preferably houses the six (6) VXI modules and other circuitry. Instead of the module cards 256 connecting directly to the VXI backplane 254, such as in the prior art VXI based system 100, the switch cards 256 connect to an internal backplane 258, which includes an analog bus 259. The carrier 252 further houses a mezzanine card 260, a controller card 262 as an option, and a bridge card 264.

Detailed Description Text (6):
The Mezzanine card 260 includes connectors for coupling to the power, VXI signal and LBUS lines of the VXI backplane bus 254. In addition the Mezzanine card 260 is coupled to the internal bus 258 via power lines. The Mezzanine card 260 is also coupled to the controller card 262, if a controller card is present, by way of VXI bus signal lines, power lines, and LBUS lines. In the preferred embodiment, the controller card 262 is piggy backed on the Mezzanine card 260 and includes direct connections to the VXI signal lines and LBUS lines. Furthermore, it is only necessary that one of the VXI plug-ins 250 of the VXI based system includes a controller 262. The controller 252 provides addressing and operating commands to

the six modules 256 and other modules (not shown) by way of the local bus (LBUS). The bridge card 264 is coupled to the VXI backplane bus 254 by way of power lines and LBUS lines, and coupled to the internal backplane 258 by way of power and digital interface signal lines.

Detailed Description Text (7):
In operation, the Mezzanine card 260 and bridge card 266 include power filtering circuits for the VXI power lines coming from the VXI backplane bus 254, and directs the filtered power to the switching cards by way of the internal backplane bus 258. The controller board 262 receives VXI signals from the VXI backplane bus 254 and decodes or interprets them to generate address and data information for potentially all the plug-ins sharing the VXI backplane bus. This address and data information is sent to each of the plug-ins by way of the local bus, LBUS. As was previously discussed, the plug-ins can be cascaded or daisy chained through the plurality of discrete segments of the local bus LBUS. The bridge board 264 receives the addressing and operating instructions from the controller card 262 by way of the LBUS to generate local address and data information for the six (6) module cards in data communication with the bridge board through the internal backplane 258.

Detailed Description Text (8):
FIG. 5 illustrates a block diagram of the Mezzanine card 260 in operating relationship with the controller 262, the VXI bus 254, and the internal bus 258. The Mezzanine card 260 preferably comprises a power filter circuit 266 coupled to the VXI bus 254 for filtering the direct current (dc) power received from the VXI bus, and providing a filtered dc voltage of +5 Volts, +24 Volts, and ground (Gnd) to the controller 262, and filtered voltages of +5 Volts, +12 Volts, +24 Volts, and ground (Grnd) to the internal backplane 258 for use by the switch cards.

Detailed Description Text (9):
FIG. 6 illustrates a block diagram of the controller board 262 in operating relationship with the VXI backplane bus 254 in accordance with the invention. The controller card 262 comprises buffers 268 and 270 coupled to the VXI bus by way of the VXI address bus and the VXI data bus. The output of the buffer 270 is coupled to the VXI LBUS controller and the VXI application specific integrated circuit (ASIC) 276 along the shared data lines. The buffer 268 is coupled to the VXI LBUS controller 272 and an additional buffer 274 along a shared address bus. The buffer 274 is, in turn, coupled to the message decoder PLD 280, to the local address port of the VXI ASIC 276, to the address port of the 68000 central processing unit (CPU) 282, to a timer 288, to a control register 290, to a status register 292, to an EPROM 294, to a RAM 296, and to a non-volatile memory 298, all along the local address bus. The local data port of the VXI ASIC 276 and the 68000 CPU are coupled together, along with the timer 288, the control register, the status register 292, the EPROM 294, the RAM 296 and the non-volatile memory 298. The inputs of the control register and outputs of the status registers 290 and 292 are coupled to a test port 300. The message decoder PLD 280 is coupled to the SDTACK port of the ASIC 276, and the LDTACK port of the VXI ASIC is coupled the DTACK port of the 68000 CPU.

Detailed Description Text (12):
FIG. 7 illustrates a block diagram of the bridge card 264 in operating relationship with the VXI bus 254 and the internal backplane bus 258 in accordance with the invention. The bridge card 260 preferably comprises a pair of differential line receivers 302 and 304, one for receiving incoming data and handshake signals from the VXI bus 254 and the other for transmitting outgoing data to the VXI bus 254. The differential line receiver 302 is coupled to a shift register 310 for converting the serial data produced at the output of the differential line driver to parallel data. The differential line driver 302 is coupled to the internal backplane 258 for providing the serial data to the switch modules. The parallel address output of the shift register 310 is coupled to the backplane interface for providing the address lines to the switch modules. In addition, the output of the

shift register 310 is coupled to the control logic (PLD) 308 to preferably provide it with the upper four bits of the parallel address. The control logic (PLD) 308 is coupled to the internal backplane by way of handshake control lines and board select lines (preferably six (6) lines, one for each switching module in the plug-in). The internal backplane 258 is coupled to the differential line driver 304 for providing thereto serial data derived from the switch modules. In addition, the bridge board 264 provides a direct path for the dc power lines (+5V, +12V, +24V, Gnd) from the VXI bus 254 to the internal bus 258. In addition, the bridge board 264 includes a voltage monitor 306 coupled to the control logic (PLD) 308.

Detailed Description Text (13):
FIG. 8A illustrates a block diagram of the internal backplane 258 in operating relationship with the bridge board 264, the mezzanine board 260, and the switch card modules 256 of the plug-in 250. The internal backplane 258 provides the board select lines (1-6) from the bridge board 264 to the corresponding modules 256. In addition, the internal backplane 258 provides the handshake signal lines and the dc power lines from the bridge board 264 to each of the modules 256. The internal backplane 258 also provides the dc power lines from the mezzanine board 260 to each of the modules 256. In addition, the internal backplane 258 also includes an analog bus 262 coupled to each of the modules 256, which is explained in more detail below.

Detailed Description Text (15):
FIG. 9 illustrates a block diagram of the switch module 256 in accordance with the invention. The switch module 256 comprises a backplane connector 272 for interfacing with the internal backplane of the plug-in. A module 256 includes a shift register 274 controlled by a control logic (PLD) 276 for converting the serial data received from the bridge board 264 by way of the internal backplane 258. The control logic (PLD) 276 receives parallel address and handshake information from the bridge board by way of the internal backplane 272. The output of the shift register 274 is coupled to each of the relay drivers 278 for providing the parallel data to the drivers. In addition, the control logic (PLD) 276 is also coupled to each of the relay drivers 278. The outputs of the relay drivers 278 are coupled to the bank of relay switches 282 for driving the selected switch or switches in accordance with the data and address information provided to the module. The outputs of the relay drivers 278, which preferably is an 8-bit bus, are coupled to corresponding shift registers 280 for sending relay status information back to the controller 262 along a tri-state serial data bus which couples back to the local bus LBUS of the VXI backplane bus.

Detailed Description Text (19):
FIG. 10 illustrates a front view of a more realistic diagram of the preferred VXI plug-in 400 in accordance with an aspect of the invention. The plug-in 400 comprises a carrier housing 402 divided horizontally into an upper compartment 404 and a lower compartment 406. The upper compartment 404 of the carrier housing 402 is sized and configured to receive therein three module cards 408 positioned horizontally adjacent to each other. The lower section 406 of the carrier housing 402 is sized and configured to receive therein three module cards 408 positioned horizontally adjacent to each other. The module cards 408 are securely attached to the carrier housing 402 by way of a plurality of screws. A fail light indicator 410, which is commonly employed in VXI modules, is situated within a space between the upper and the lower sections for indicating whether the controller card has failed its power-on self-test. A pair of injector/ejector handles 412 are preferably positioned near the top and bottom of the carrier 400. They facilitate the secured insertion and removal of the plug-in from the chassis and backplane connection, as will be explained in more detail later. One or more of the module cards 408 can include connectors 414 for interfacing with a unit-under-test (UUT) or other devices.

Detailed Description Text (20):

FIG. 11 illustrates a front perspective view of the VXI plug-in 400 shown in FIG. 10, with one module card 408a totally removed from the carrier housing 402 but in registered position with the corresponding carrier slot, and another module card 408b partially removed from the corresponding carrier slot. A thin sheet 416 of conductive material is positioned between the module cards 408a and 408b for electromagnetically isolating the cards. Preferably the thin conductive sheet 416 extends substantially the full width and length of the module boards so that optimum isolation is provided. The thin sheet 416 is preferably grounded to a grounding plane on the internal backplane bus (not shown in FIG. 11). All module cards 408 are preferably separated from respective adjacent cards by such a thin conductive sheet 416.

Detailed Description Text (22):
The mezzanine and bridge cards 422 and 424 each include a pair of connectors 432 for mating with corresponding connectors on the VXI backplane. The controller board, when present, is stacked on top of the mezzanine board, and spaced apart from each other by one or more stand-offs 434. When the controller board 426 is provided and is vertically stacked on top of the mezzanine board 424, a plurality of pins on the controller board are in registered position with a plurality of holes on the mezzanine board 424 to provide a registered connection of the connector pins 432 to the pins of the controller board. Thus, the controller board 426 is directly connected to the VXI backplane when the plug-in is fully inserted into the VXI chassis. In the preferred embodiment, the board layout or traces of the mezzanine board 424 and the bridge board 422 are the same, but are populated with different components. This has the advantage of providing one board type for both applications.

Detailed Description Text (23):
The VXI plug-in 400 includes an internal backplane board 436 positioned within the carrier housing 402 in a manner that it forms a wall that divides the front compartment 418 from the rear compartment 420 of the carrier housing. The front side of the backplane board 436 preferably includes six (6) connectors (not shown) for mating with corresponding connectors of the six module cards 408. The rear side of the backplane board includes connectors for mating with connectors on the mezzanine and bridge boards.

Detailed Description Text (24):
FIG. 13 illustrates a side elevation view of the VXI plug-in 400. As previously mentioned, the plug-in 400 includes a pair of injecting and ejecting mechanisms 412. These mechanisms 412 facilitate the secured insertion and removal of the plug-in from the VXI chassis and backplane connection. The mechanism 412 is rotatably or pivotably mounted to respective L-shaped brackets 438 situated on the top and bottom of the carrier housing as seen in FIG. 10.

Detailed Description Text (25):
FIG. 14 illustrates a rear perspective view of a standard VXI chassis or mainframe 500 configured in accordance with an aspect of the invention. The VXI mainframe 500 comprises a front compartment 502 for housing the VXI product modules, and a rear compartment 504 for housing a power supply unit 506. The VXI mainframe 500 includes a VXI backplane 508 mounted to a chassis dividing wall 509 that separates the front compartment 502 from the rear compartment 504. The mainframe 500 includes a plurality of slot rails 510 situated in the front compartment 502 for guiding the VXI plug-ins as they are inserted into the chassis. The VXI backplane 508 includes a plurality of connectors (not shown) on the front side of the backplane 504 that are coincident with the connector hole patterns 512 shown on the back of the VXI backplane 508. At the lower end of dividing wall 509 are mounted a plurality of connectors 514 that mate with corresponding connectors on the power supply unit 506. This feature allows the power supply unit to be connected directly to the VXI backplane, without the need for wire harnesses or the like.

Detailed Description Text (28):
In operation, when the plug-in is being inserted into the chassis, the injection/ejection mechanism 412 is positioned angularly such that the injection protrusion 446 lies above the lip 452 of the rail 450. As the plug-in is further inserted into the chassis, the injection protrusion 446 moves behind the lip 452. At the same time, the plug-in connectors reach the mating connectors of the VXI backplane. The handle 440 is then moved upward so that the injection/ejection mechanism 412 rotates in a counter-clockwise direction about the pivot point 444. This action causes the injection protrusion 446 to push against the back of the lip 452 which forces the plug: in to move forward in order to position its connectors in a mating and friction fit relationship with the connectors of the VXI backplane bus. When the plug-in is to be removed, the handle 440 is rotated downward to cause the injection/ejection mechanism 412 to rotate in a clockwise direction about the pivot point 444. This action causes the ejection protrusion 448 to push against the end 454 of the rail 450 which forces the plug-in to move backward in order to remove its connectors from the mating and friction fit relationship with the connectors of the VXI backplane.

CLAIMS:

1. A VXI product plug-in comprising:

a carrier housing having front and rear compartments, wherein said front compartment is further partitioned into upper and lower sub-compartments;

a first set of module cards situated within the upper sub-compartment of the front compartment of the carrier housing;

a second set of module cards situated within the lower sub-compartment of the front compartment of the carrier housing;

at least one interfacing card situated within the rear compartment of the carrier housing for interfacing at least one of the module cards with a VXI bus;

an internal backplane bus situated within the carrier housing and between the front and rear compartments, said internal backplane bus being coupled to said module cards and said interfacing card; and

said plug-in being sized and dimensioned to occupy two adjacent standard slots of a standard VXI chassis.

2. The VXI product plug-in of claim 1, wherein said at least one interface card includes a mezzanine card for providing a conduit of power lines from the VXI bus to the internal backplane and for providing filtering of dc power residing in said power lines.

5. The VXI product plug-in of claim 1, wherein said internal backplane includes a bus for selectively coupling any of said module cards together.

9. A VXI based system, comprising:

a standard VXI chassis including front and rear chassis compartments, said front chassis compartment having a plurality of standard size slots;

a VXI backplane including a VXI bus situated within said chassis between said front and rear chassis compartments;

a plurality of VXI product plug-ins situated within said slots, including a first plug-in configured to occupy two adjacent standard size slots;

each said plug-in including a carrier housing having a front plug-in compartment and a rear plug-in compartment, wherein said front plug-in compartment is further partitioned into upper and lower sub-compartments;

a first set of said module cards situated within said upper sub-compartment of said front plug-in compartment;

a second set of said module cards situated within said lower sub-compartment of said front plug-in compartment;

at least one interfacing card situated within said rear plug-in compartment for interfacing at least one of said module cards with a VXI bus;

an internal backplane bus situated within said first plug-in and between said front and rear plug-in compartments, said internal backplane bus being coupled to said module cards and said interfacing card; and

a power supply unit situated within said rear chassis compartment of said chassis for supplying power to said VXI product plug-ins.

10. The VXI based system of claim 9, wherein said at least one interface card includes a mezzanine card for providing a conduit of power lines from the VXI bus to the internal backplane and for providing filtering of dc power residing in said power lines.

14. The VXI based system of claim 9, wherein said internal backplane includes a bus for selectively coupling any of said module cards together.

19. A VXI based system, comprising:

a standard VXI chassis including front and rear chassis compartments, said front chassis compartment having a plurality of standard size slots;

a VXI backplane including a VXI bus situated within said chassis between said front and rear chassis compartments;

a plurality of VXI product plug-ins situated within said slots, including a first plug-in configured to occupy two adjacent standard size slots;

said first plug-in including a carrier housing having a front plug-in compartment and a rear plug-in compartment;

said front plug-in compartment of said first plug-in including a plurality of module cards;

at least one interfacing card situated within said rear plug-in compartment for interfacing at least one of said module cards with said VXI bus of said VXI backplane;

an internal backplane bus situated within said first plug-in between said front and rear plug-in compartments, said internal backplane bus being electrically coupled to said module cards and said interfacing card; and

a power supply unit situated within said rear chassis compartment of said chassis for supplying power to said VXI product plug-ins.

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U.S. PATENT DOCUMENTS

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ABSTRACT:

A VXI product plug-in is provided herein that is capable of higher component density. The plug-in is configured to occupy two standard size slots of a standard VXI chassis, and includes two sets of three horizontally stacked modules in upper and lower sub-compartments of a front compartment of the plug-in carrier. The six modules have the capability of being populated with 480 switching relays, which provides for a 50 percent increase in the number of switches over the prior art plug-ins. The plug-in carrier includes a rear compartment that houses a VXI bus interfacing circuit, including a mezzanine board, a bridge board, and optionally a controller board, for interfacing the switch modules with a VXI backplane bus. The Plug-in further includes an internal backplane situated within the carrier between the front and rear compartments that provides an interface between the modules and the VXI bus interfacing circuit, and specifically, include a bus that can selectively couple modules together. Other aspects of the invention include an automatic updating scheme for updating the software installed on the controller card so that it has the necessary data and program code to operate new modules, an emergency reset mechanism for opening all relays pertinent to one module, and a mechanism for facilitating the insertion and removal of a VXI plug-in to and from a VXI chassis.

20 Claims, 16 Drawing figures

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L8: Entry 9 of 23 File: USPT May 2, 2000

DOCUMENT-IDENTIFIER: US 6058019 A
TITLE: Electronic circuit card assembly having confined ground path return

Abstract Text (1):
An electronic system contains a backplane circuit card assembly for distribution of electrical signals among component devices. Power is distributed in embedded power planes, one of which is associated with ground. The backplane also contains multiple embedded ground planes. The circuit card assembly is divided by an axis into two halves, each half receiving and consuming approximately equal power. Electrical couplings for power sources and power planes in each half of the backplane are located symmetrically with respect to the axis. A row of ground vias along

Abstract Text (2):
the axis couples the ground planes to the associated power plane. At all other locations on the backplane, the ground planes are electrically isolated from the associated power plane. Preferably, the backplane assembly comprises a pair of base cards, connected by a single smaller jumper card in which all ground vias are located. Each base card lies on a respective side of the axis, the jumper straddling the axis. The exemplary embodiment is an intelligent redundant array of independent disks (RAID) storage server having concurrent maintenance capability.

Brief Summary Text (2):
The present invention relates to electronic circuit cards, and in particular to "backplane" cards of a type used to distribute power or other signals to other attached modules.

Brief Summary Text (9):
Electronic systems frequently use backplane circuit cards for distribution of power, data signals, and/or mounting of active or passive circuit elements and connectors. Such a card typically contains multiple parallel layers for embedded circuit patterns, grounds, or power distribution. Pluggable connectors couple the backplane to other modules which make up the electronic system, such as power supply modules, storage devices, or logic cards. Often, such a backplane card acts primarily as a distribution medium, i.e., it conveys power and/or data signals from one module to another, and contains relatively few functional components attached directly to the backplane itself. However, the backplane may contain functional components.

Brief Summary Text (10):
A backplane may contains embedded power planes for distributing electrical power to pluggable modules or other attached devices. It may also contain a multiple ground planes. Typically, one of the power planes (e.g., 0 V) is associated with ground, and must be grounded. Grounding means that electrical paths of negligible resistance are created between ground planes and the 0 V power plane. The existence of such paths can cause parasitic current to flow in the ground planes, which lowers the noise immunity of the system.

Brief Summary Text (11):
It is desirable to reduce the parasitic current flowing in the ground planes of a

backplane circuit card, particularly a backplane which distributes power to multiple pluggable modules.

Brief Summary Text (14):
Another object of this invention is to provide an enhanced backplane circuit card for use in electronic systems.

Brief Summary Text (15):
Another object of this invention is to reduce the parasitic current flowing in ground planes of a backplane circuit card.

Brief Summary Text (16):
An electronic system, such as a digital computer system or a subsystem thereof, contains a backplane circuit card assembly for distributing power and/or data signals among component devices. Power is distributed in embedded power planes, one of the power planes being associated with ground. The backplane also contains multiple embedded ground planes. The circuit card assembly is divided by an axis into two halves, each half consuming approximately equal power, and each half receiving approximately equal power from a power source. The electrical couplings between power sources and power planes of the circuit card assembly in each half of the backplane are located symmetrically with respect to the axis. A row of ground vias located along the axis couples the ground planes to the associated power plane. At all other locations on the backplane, the ground planes are electrically isolated from the associated power plane.

Brief Summary Text (17):
Preferably, the backplane assembly comprises a pair of base cards, connected by a single smaller jumper card. The base cards are positioned in a single plane, with one edge of each base card lying near a corresponding edge of the other base card. The jumper is positioned parallel to and slightly offset from the base cards, the offset being needed to provide space for pluggable connectors which couple the jumper card to each of the base cards. Each base card lies on a respective side of the axis, the jumper straddling the axis. All ground vias are located in the jumper.

Brief Summary Text (18):
In the preferred embodiment, the electronic system includes multiple redundant power supply modules for supplying electrical power, and multiple redundant functional modules which perform some data processing function. Modules plug into the backplane card assembly using pluggable connectors capable of being unplugged and re-plugged. Each base card distributes electrical power from at least one power supply module directly coupled to it, i.e., without power coming through the other base card. Each base card further carries data signals among various modules coupled to it, independently of the other card. The power supply and functional modules directly attached to any one base card are sufficient to maintain minimum functionality of the electronic system, in the absence of the other base card.

Brief Summary Text (21):
In the preferred embodiment, the electronic system is an intelligent redundant array of independent disks (RAID) storage server, for providing data to multiple host digital data processing systems. The storage server includes a plurality of disk drives and power supplies housed within an enclosure, together with supporting electronic logic cards and other hardware. The various components provide redundant operation in the event of a single failure. Certain logic cards, power supplies and other modules plug into the backplane circuit card, which functions as a distribution medium for power and data signals. The design of the server system, including the design of backplane circuit card and couplings, supports concurrent maintenance, whereby any component can be unplugged from the backplane circuit card, removed from the enclosure, and replaced with a functioning unit, all without powering down the subsystem. Additionally, the backplane itself is split into

multiple circuit cards having duplicative function as described above, so that concurrent maintenance can be performed on the backplane itself.

Drawing Description Text (2):
FIG. 1 shows the major components of a RAID subsystem using a backplane circuit card in accordance with the preferred embodiment of the present invention.

Drawing Description Text (4):
FIGS. 3A and 3B are isometric perspective views of the left section backplane circuit card according to the preferred embodiment.

Drawing Description Text (5):
FIGS. 4A and 4B are isometric perspective views of the right section backplane circuit card according to the preferred embodiment.

Drawing Description Text (7):
FIG. 6 is a cross-sectional view of a representative portion of one of the backplane circuit cards, showing the various conductive and non-conductive layers, according to the preferred embodiment.

Drawing Description Text (8):
FIG. 7 is a view of a voltage power plane for left section backplane circuit card, showing the location of islands and power ramps, according to the preferred embodiment.

Drawing Description Text (9):
FIG. 8 is a view of a voltage power plane for right section backplane circuit card, showing the location of islands and power ramps, according to the preferred embodiment.

Drawing Description Text (12):
FIG. 11 is an exploded perspective view of the mounting frame for the electronics drawer, showing the mounting locations of the backplane circuit card assembly, according to the preferred embodiment.

Detailed Description Text (2):
FIG. 1 is a high level representation of the major components of server system 100 employing the backplane circuit cards of the present invention, in accordance with the preferred embodiment. In this embodiment, server system is an intelligent and redundant mass repository of data, which it provides on demand to multiple host computer systems which are connected to server system 100. System 100 comprises a frame 101 for housing various electronic modules. These modules are shown in FIG. 1 in slide-out position for illustrative purposes, it being understood that during normal operation the modules are fully inserted in frame 101.

Detailed Description Text (10):
Drawer 102 further includes reserved spaces for later system enhancements, depicted in FIGS. 2A and 2B as modules 205-208 and 213-216. Modules 213-216 are intended as additional I/O communications modules, similar in function to modules 209-212. Modules 205 and 206 are intended as optional performance enhancement modules, which may include cache and other logic to increase the performance of the storage subsystem. Modules 207 and 208 are intended as additional non-volatile random access memory (NV RAM), which temporarily store data bound for storage devices located in storage drawers 104-107. Modules 205-208 and 213-216 are shown in FIGS. 2A and 2B although in fact they are not supported by the backplane card design of the preferred embodiment. Support for these modules may require modifications to backplane sections 220 and 221 so that the backplanes would mount connectors supplying power and data signals to the modules.

Detailed Description Text (11):

Modules are electrically connected to one another for distribution of power and data signals by means of a three-part system backplane, comprising left backplane circuit card section 220, right backplane circuit card section 221, and backplane jumper card section 222. As used herein, the term "module" includes any electronic subassembly, such as circuit cards and card cages, as well as fully enclosed modules. Left section 220 and right section 221 are similar, and provide essentially duplicative function. I.e. left section 220 couples the various modules located on the left side of drawer 102, providing power to the modules and permitting data to flow between modules. Right section accomplishes the analogous task for the modules on the right side of drawer 102. Jumper section 222 is smaller than either section 220 or 221. Jumper 222 electrically connects the other two sections, allowing signals to pass between them and distributing power, and provides grounding connections, as explained further herein. Dividing the backplane into two separate sections linked by a jumper, each having duplicative function, makes it possible to replace one of the backplane sections while the other continues to function. While it would have been possible (and generally cheaper) to provide a single larger backplane circuit card, the three part design enhances the concurrent maintenance capability of the system.

Detailed Description Text (13):
FIGS. 3A and 3B are perspective views of left section backplane circuit card 220 according to the preferred embodiment. FIG. 3A shows the front side of card 220, while FIG. 3B shows the back side. On the back side and near the top of card 220 can be seen a pair of power connectors 301. Beneath power connectors 301 is a set of three signal connectors 302. Power connectors 301 and signal connectors 302 mate with corresponding connectors 501 and 502 respectively on jumper card 222 to form the connection with the jumper card. Additional connectors mate with corresponding connectors on the various modules. Specifically, power supply connectors 303 mate with left power supply 201; card cage connectors 305 mate with connectors of a power supply (not visible) in left card cage 203 which provides power at working voltages and status information for main processor cards 241, memory cards 243, various V/O cards 245, etc.; I/O card connectors 306 mate with connectors in card cage 203 for the various I/O cards 245; and I/O module connectors 307 mate with the left I/O adapter modules 211 and 212. Embedded signal lines are formed in a plurality of conductive planes in circuit card 220, running between the various connectors. Holes 310 in card 220 allow cooling air to pass through the backplane.

Detailed Description Text (14):
FIGS. 4A and 4B are perspective views of the right section of backplane circuit card 221, according to the preferred embodiment. Circuit card 221 is generally similar in construction and function to card 220. FIG. 4A shows the front side of card 221, while FIG. 4B shows the back side. Power connectors 401 and signal connectors 402 form connections to connectors 503 and 504 respectively of jumper card 222, similarly to left section card 220. Power supply connectors 403 mate with right power supply 202; card cage connectors 405 mate with connectors of a power supply (not visible) in right card cage 204 which provides power at working voltages and status information for main processor cards 242, memory cards 244, various I/O cards 246, etc.; I/O card connectors 406 mate with connectors in card cage 204 for the various I/O cards 246; and I/O module connectors 407 mate with right I/O adapter modules 209 and 210. Embedded signal lines are formed in a plurality of conductive planes in circuit card 221, running between the various connectors. Holes 410 permit the passage of cooling air.

Detailed Description Text (16):
Power monitor connectors 510 and 511 receive the mating connectors of corresponding redundant cables (not shown) which run between jumper 222 and redundant 350 VDC power supplies in power drawer 103. These connectors and cables do not carry power, but carry data signals used for monitoring and regulating power. Specifically, power is continually regulated so that, under normal operating conditions, power supply 201 provides all power to modules attached to circuit card 220, while power

supply 202 provides all power to modules attached to circuit card 221. The power provided by these power supplies is thus balanced, so that no power current is flowing through the jumper from one half of the backplane to another. However, where one power supply fails, its redundant neighbor will supply power to the other half of the backplane through the jumper.

Detailed Description Text (18):
FIG. 6 is a cross-sectional view of a representative small portion of one of backplane circuit cards 220, 221 or 222, according to the preferred embodiment. Conductive layers 601-618 alternate with non-conductive (dielectric) layers 621-637. Layers 603, 604, 606, 607, 612, 613, 615, and 616 are internal signal layers, i.e., signal layer planes which are buried in the middle of the circuit card. Layers 601 and 618 are signal layers lying on either surface of the card. Ground layer planes 602, 605, 608, 611, 614 and 617 provide impedance control for adjacent signal layers.

Detailed Description Text (21):
Except in jumper 222, ground vias are insulated from the 0 VDC power plane. I.e., on cards 220 and 221, ground planes 602, 605, 608, 611, 614 and 617 are not electrically connected to 0 VDC power plane 610. The tying of 0 VDC power to ground is accomplished in jumper 222. Specifically, ground plugs 521 and 522 include pins extending through the width of jumper 222, which are electrically connected to each ground plane and to 0 VDC. Additionally, a row of ground vias 523 runs down the center of card 222 between plugs 521 and 522, each via electrically connecting all ground planes and the 0 VDC power plane. Each ground plane within the left 220 or right 221 half backplane is electrically connected to its corresponding ground plane in jumper 222 through pins in connectors 302, 402, 502 and 504. Thus, the 0 VDC is electrically isolated from the ground planes everywhere on the backplane assembly except down the middle of the jumper (by "electrically isolated", it is meant that there exists no direct electrical connection having negligible impedance, although there may be current paths through components having significant though finite impedance).

Detailed Description Text (22):
Because jumper 222 is substantially symmetrical, and power is balanced between the two halves of the backplane as described above, the power plane voltage potential along row of vias 523 and ground plugs 521, 522, should be equal. Thus, any recirculating electrical current due to ground loops is effectively minimized. For purposes of minimizing ground loop current, this design is similar to a single point of grounding the 0 VDC power plane.

Detailed Description Text (28):
Void 712 nearly surrounds hole groups 701 and 703, and defines a ramp to the right of group 703. The comparatively large island defined by this void encompasses all the power supply connections. I.e., hole group 703 corresponds to the connector to power supply 201, which normally supplies power to backplane section 220. In the event of failure or absence of supply 201, power to backplane section 220 is provided by power supply 202, through the connections in jumper card 222. This power is routed through power connector 301, corresponding to hole group 701. Thus the power to card 220 is always routed through the island defined by void 712, regardless of which power supply is actually providing it. Conversely, if power supply 202 should fail, requiring power supply 201 to double its output in order to supply the power needs of card 221 and its attached modules, the additional current is routed through the island defined by void 712, without traversing the body of the power planes in card 220.

Detailed Description Text (35):
The island and ramp configuration helps to reduce the effect of transients, particularly those caused by unplugging or plugging a module. For example, without the island and ramp, if a module which is powered on (i.e., receiving power) is

suddenly unplugged from the backplane, so that power is abruptly disconnected, there is a sudden large change in the electrical current density function for the power plane, which is particularly acute in the vicinity of the pins which supply power to a module. Similarly, plugging a powered-off module into the backplane causes a large current spike (and possible arcing) as a result of sudden application of voltage to what is effectively a large discharged capacitor. The resulting induced magnetic field can corrupt data signals in one or more of the signal planes.

Detailed Description Text (40):
For example, in the backplane circuit card of the preferred embodiment, dielectric layer 629 separating the two power planes is approximately 0.124 mm thick. This is actually only slightly thinner than some other dielectric layers in the circuit card, but in view of the fairly large power load being carried by the power planes, such a dimension is deemed desirable. Where a card is used to distribute smaller power loads or other parameters are different, it may be possible to design a thinner insulating layer between the power planes. Dielectric layers 628 and 630, separating the power planes from ground planes 608 and 611, are each approximately 0.130 mm thick, while dielectric layers 627 and 631, separating ground planes 608 and 609, respectively, from adjacent signal planes, are each approximately 0.188 mm thick. These dimensions do not necessarily represent an ideal from the standpoint of electromagnetic transient isolation, but were chosen in order to achieve other goals as well, such as manufacturability and cost.

Detailed Description Text (44):
FIG. 11 is an exploded perspective view of the mounting frame and associated hardware for electronics drawer 102, according to the preferred embodiment. The mounting frame includes U-shaped bottom-and-side section 1101 and top section 1102, both of which are formed sheet steel containing appropriate mounting holes, tabs and other features. The backplane assembly, comprising cards 220, 221 and 222, is positioned approximately in the center of section 1101, perpendicular to the sides and bottom. A sheet steel stiffener 1103 is attached to section 1101, and positioned parallel to cards 220, 221 and 222. Stiffener 1103 contains holes for cooling airflow corresponding to the various holes in cards 220 and 221. Stiffener 1103 also contains holes for various connectors mounted on cards 220, 221 and 222. Cards 220 and 221 are mounted on the front side of stiffener 1103, while card 222 is mounted on the rear side. Thus, stiffener 1103 lies in a plane between the jumper and the two functional halves. A thin plastic insulator (not shown) prevents electrical contact between cards and stiffener.

Detailed Description Text (46):
Grounding bus bar 1105 forms a frame ground for the backplane assembly. Ground bar 1105 is attached to jumper 222 via screws at plugs 521 and 522, the two screw locations providing redundant attachment to the jumper. Bar 1105 is also attached to top section 1102 via two redundant screws. This arrangement of ground bar 1105 also provides additional structural support to the backplane circuit card assembly.

Detailed Description Text (47):
In the preferred embodiment described above, the backplane assembly contains three separable parts (sections 220, 221 and 222), which are joined by pluggable connectors. This design permits concurrent maintenance of the two major backplane sections. However, it would alternatively be possible to employ a unitary backplane circuit card in which the ground vias are located on a dividing axis. In such a case, it may be desirable (though not always necessary) to narrow the region in which the ground vias are located. For example, non-conductive voids located along the axis could divide the power planes into two halves, joined only along part of the length of the axis, the ground vias being located in this region.

Detailed Description Text (48):

In the preferred embodiment, each 48 VDC power supply is allocated to one of the halves of the backplane and under normal conditions supplies all its power. However, various redundant and non-redundant alternatives are possible. A single power supply could be connected to both halves of the backplane at symmetrical locations with respect to the axis. Alternatively, a pool of two or more redundant power supplies could be coupled to a common power bus, each half of the backplane having its independent connection to the bus, so that no one power supply is directly associated with any section of the backplane. It would further be possible to have multiple redundant power buses.

Detailed Description Text (49):
In the preferred embodiment described above, jumper card 222 is non-redundant and constitutes a possible single point of failure for the system. Because jumper 222 contains no attached components other than connectors (contains no active devices, resistors, capacitors, etc.), the probability of jumper failure is considered extremely low, and accordingly this portion of the system is non-redundant. However, it would have alternatively been possible to design the system in such a way that the jumper itself could be concurrently maintained and replaced. There are several ways in which this could have been done. It would have been possible to construct the backplane with a second jumper card, located between the left and right circuit cards below jumper 222. In this case, it would not have been necessary to place both power monitor connectors 510 and 511 on jumper 222; one such connector would be on jumper 222, while the other would be on the second jumper (the system being capable of operation with only one such power monitor connection). Another alternative would have been to relocate power monitor connectors 510 and 511 to the left and right circuit cards respectively, and construct a second jumper card having extremely limited function. I.e., the second jumper would only contain the ground vias connecting the 0 VDC, ground planes, and chassis ground, without any transmission of data. Because each half of the backplane is independently capable of supporting a system, data running between the two halves is not necessary for minimal operation. However, in any implementation which would disrupt communications between the two halves during concurrent maintenance, it would be necessary for control software to temporarily shut down one half of the system or otherwise guarantee resynchronization of the two parts of the system after data communication is restored.

Detailed Description Text (50):
In the preferred embodiment, the power planes are located in the middle of the various layers which make up the circuit card, with signal planes located on either side of the power planes. This arrangement buries the power planes far from components on either side of the backplane. However, it would alternatively be possible to locate the power planes near a surface of the card, with all signal planes being located to one side of

Detailed Description Text (51):
the power planes. This arrangement may prove advantageous if, e.g., connectors and other components are located on only one side of the backplane.

Detailed Description Text (52):
In the preferred embodiment, the backplane is used only for distribution of power and signals among pluggable components, and itself contains no active functional electronic components. However, it would alternatively be possible to construct a backplane assembly as described herein, which also carries functional components such as processors, switches, programmable logic arrays, etc. If redundancy is desired, it may be necessary to duplicate functional components on different sections of the backplane.

Detailed Description Text (53):
In the preferred embodiment, a backplane circuit card for power distribution is designed to pluggably receive both the modules which supply power and the modules

which consume power. However, it would alternatively be possible to construct systems in which any single backplane receives only modules of a single type. For example, a backplane may have several pluggable couplings for receiving disk drive modules (consumers of power), and be connected by flexible cable or any of various other conventional connection means to one or more power supplies, or to a second backplane into which one or more power supplies are plugged.

Detailed Description Text (54):
In the preferred embodiment, a pair of power planes is used to distribute power at a voltage somewhat higher than normally used by semiconductor circuits. The higher distribution voltage (48 volts) reduces current in the distribution medium. It is expected that each module will have circuitry necessary to produce working voltages such as 5 volts. However, it would alternatively be possible to construct a system in which all working voltages are distributed on the power planes, or in which a combination of higher distribution voltages and working voltages are distributed on the power planes. In this case, more than two power planes may be necessary. For example, a backplane circuit card may have three power planes, for 0, +5 and +12 volts, each power plane having corresponding islands as described herein. As an alternative example, the backplane may contain power planes at +48VDC distribution voltage, 0 VDC return distribution voltage, +5 VDC working voltage, and 0 VDC return working voltage.

Detailed Description Text (55):
In the preferred embodiment, pins which carry power to or from the backplane are surrounded by islands and ramps in order to reduce the effects of transients during hot plugging. However, it would alternatively be possible to construct a backplane assembly as described herein without island or ramps. Such a backplane may be constructed, e.g., without pluggable power connections; or with power connections having other forms of transient suppression such as active circuit elements; or with power connections which are shut down before insertion and removal of modules so that hot plugging is not necessary; or employing a system design which in some other way modifies or tolerates transients resulting from hot plugging.

CLAIMS:

1. An electronic system, comprising:

a frame;

at least one power supply module mounted within said frame for providing power to functional components of said system;

a backplane circuit card assembly having first and second functional halves mounted within said frame, said functional halves consuming substantially equal power and being divided by an axis, said backplane circuit card assembly coupled to said at least one power supply module and distributing electrical power to functional components of said system, said backplane circuit card assembly comprising:

a first embedded power plane for conducting a first voltage;

a second embedded power plane for conducting a second voltage, said second voltage being associated with ground;

a plurality of embedded ground planes;

a first power connection within said first functional half for receiving power from said at least one power supply module;

a second power connection within said second functional half for receiving power from said at least one power supply module, wherein said first and second power

connections are symmetrically located with respect to said axis; and

a plurality of ground vias located along said axis, each said ground via electrically connecting said plurality of embedded ground planes and said second embedded power plane;

wherein said embedded ground planes are electrically isolated from said second embedded power plane at all locations within said backplane circuit card assembly except at said ground vias located along said axis.

2. The electronic system of claim 1, further comprising:

a chassis ground electrically connecting said frame to said backplane card assembly, said chassis ground being connected to said backplane card assembly at at least one location along said axis.

3. The electronic system of claim 2, wherein said chassis ground comprises an L-shaped conductive bar, one leg of said bar being coupled to said backplane assembly at a plurality of locations along said axis, the other leg of said bar being coupled to said frame.

4. The electronic system of claim 1, wherein said backplane circuit card assembly comprises:

a left base circuit card corresponding to said first functional half;

a right base circuit card corresponding to said second functional half; and

a jumper card mounted between and joining said left and right base circuit cards, said plurality of ground vias being located in said jumper card.

5. The electronic system of claim 1, wherein:

said frame forms the outlines substantially rectangular parallelepiped;

said backplane circuit card assembly is mounted substantially perpendicular to the top, bottom and sides of said frame, and dividing the interior of said parallelepiped into front and rear regions;

a first plurality of electronic modules are mounted in said front region; and

a second plurality of electronic modules are mounted in said rear region.

6. The electronic system of claim 5, wherein:

said backplane circuit card assembly comprises a left base circuit card and a right base circuit card, said left and right base circuit cards being mounted within a left half of the interior of said parallelepiped and a right half of the interior of said parallelepiped, respectively;

said system includes a plurality of left side electronic modules which plug into said left base circuit card, and a plurality of right side electronic modules which plug into said right base circuit card;

said plurality of left side electronic modules includes at least one left power supply module for supplying power to said left base circuit card; and

said plurality of right side electronic modules includes at least one right power supply module for supplying power to said right base circuit card.

7. The electronic system of claim 1, further comprising:

a plurality of power supply modules, each power supply module being associated with a respective half of said backplane circuit card assembly and supplying power to the respective half with which it is associated.

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L8: Entry 9 of 23 File: USPT May 2, 2000

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PARENT-CASE:
RELATED APPLICATION The present application is a continuation-in-part of U.S. patent application Ser. No. 09/082,897, filed May 21, 1998, by Douglas A. Kuchta et al., entitled "Multi-Part Concurrently Maintainable Electronic Circuit Card Assembly", which is herein incorporated by reference. The present application is related to commonly assigned copending U.S. patent application Ser. No. 09/146,010, filed Sep. 2, 1998, by Maurice L. Hutson et al., entitled "Electronic Circuit Card Having Transient-Tolerant Distribution Planes", which is herein incorporated by reference.

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PRIOR-ART-DISCLOSED:

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ART-UNIT: 285

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ABSTRACT:

An electronic system contains a backplane circuit card assembly for distribution of electrical signals among component devices. Power is distributed in embedded power planes, one of which is associated with ground. The backplane also contains multiple embedded ground planes. The circuit card assembly is divided by an axis into two halves, each half receiving and consuming approximately equal power. Electrical couplings for power sources and power planes in each half of the backplane are located symmetrically with respect to the axis. A row of ground vias along

the axis couples the ground planes to the associated power plane. At all other locations on the backplane, the ground planes are electrically isolated from the associated power plane. Preferably, the backplane assembly comprises a pair of base cards, connected by a single smaller jumper card in which all ground vias are located. Each base card lies on a respective side of the axis, the jumper straddling the axis. The exemplary embodiment is an intelligent redundant array of independent disks (RAID) storage server having concurrent maintenance capability.

L8: Entry 22 of 23 File: USPT May 24, 1983

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TITLE: Bargraph display

Detailed Description Text (3):
Mandrel 5 constitutes the display-tube base as well as the "form" on which the "ladder" array of wire segments w is wound and mounted; this winding presenting each top segment (turn) in operative, cold-cathode-display relation with another electrode means and associated electronic drive means. As better seen in FIGS. 3 and 5, the mandrel 5 is thus constructed to present a novel "back-plane" anode (electrode strip A) at a prescribed discharge-distance from the upper medial segments of each turn wound on the mandrel, and "behind" them (i.e. away from the viewer). These cathode segments are presented as fixed, regularly spaced turns--i.e. a "ladder" format--on mandrel 5, being wound (e.g. manually, or by machine as known in the art) thereon as a continuous-wire conductor, with inter-segment pitch being established by stepping the winding a prescribed distance across the "back" (non-discharge) side of mandrel 5. As workers know, cathode spacing is one factor determining firing voltage, and accordingly, the turns should be close enough together to effectively transfer the glow and quick, when activated in the known manner.

Detailed Description Text (12):
As seen in FIGS. 1 and 5, electrical connection means is provided to the bar segments (here 50 wire pairs tied to segments WC) by PC Board 51, mounted, with the display tube, onto block 61. Insulating board 51 is relatively conventional, presenting a set of connector terminal tabs on each side (front set 51-T; rear set 51-TR), each tab being connected to a respective solder post (through-hole posts 51-C for front tabs 51-T; "thru-hole" posts 51-PR for rear tabs 51-TR) by connectors 51-C. With posts 51-P, 51-PR formed as hollow posts, leads WC may be conveniently inserted therein and soldered-in as shown in the art. Block 61 acts as an insulative mount and PCB stiffener and may comprise any insulator bonded to board 51 and to the display (e.g. epoxy bonded).

Detailed Description Text (15):
According to a novel feature thereof, a raised cathode gas display is taught wherein the anode is mounted "behind" the cathode rather than in front. Workers will appreciate that, unlike other displays (e.g. screen printed displays for example), the raised-cathode type (see U.S. Pat. No. 3,675,066) allows the use of an anode mounted "behind" (as viewed from the front of the display) the raised cathode structure. Such a "back-plane-mounted" anode has the advantage of being much less expensive to provide than the tin oxide (NESA) transparent anodes common to the art; also such anodes can be more accurately positioned relative to the cathode structure; further, the electrical connection to such an anode is more readily accomplished.

Detailed Description Text (16):
This disclosure specifically describes the use of such a "back-plane" anode (any electrically conducting material mounted behind the cathode structure) whether the application be for a bargraph display as herein described, for a multiple segment display (such as the Beckman planar gas discharge displays--see SP-series) or for any other similar structure.

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L8: Entry 22 of 23 File: USPT May 24, 1983

US-PAT-NO: 4385260
DOCUMENT-IDENTIFIER: US 4385260 A

TITLE: Bargraph display

DATE-ISSUED: May 24, 1983

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Watts; Geoffrey P.	Mesa	AZ		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Beckman Instruments, Inc.	Fullerton	CA			02

APPL-NO: 05/ 611743 [PALM]
DATE FILED: September 9, 1975

INT-CL: [03] H01J 61/06, H01J 61/30

US-CL-ISSUED: 315/169.2; 340/754, 445/24, 313/583, 313/609, 313/632
US-CL-CURRENT: 315/169.2; 313/583, 313/609, 313/632, 445/24

FIELD-OF-SEARCH: 315/169R, 315/169TV, 315/169.2, 340/166EL, 340/173PL, 340/324M, 340/336, 340/754, 316/1, 316/17, 29/25.1, 29/25.15, 313/514, 313/517, 313/519, 313/188, 313/210, 313/204, 313/217, 313/220

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3863087	January 1975	Holz	313/188

ART-UNIT: 256

PRIMARY-EXAMINER: La Roche; Eugene

ATTY-AGENT-FIRM: Steinmeyer; R. J. Mehlhoff; F. L. May; William H.

ABSTRACT:

Bargraph displays wherein the illuminable bar segments are formed by winding filamentary conductors upon a mandrel.

11 Claims, 14 Drawing figures

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L5: Entry 2 of 3 File: USPT Jun 16, 1992

DOCUMENT-IDENTIFIER: US 5122691 A
TITLE: Integrated backplane interconnection architecture

Brief Summary Text (4):
A typical implementation of a bus consists of a set of traces embedded in print circuit (PC) board. Modules connect to the bus through bus transceivers. Modules connected to a bus may all reside on the same PC board. Alternately, modules of a bus may reside on separate PC boards and be attached to the electro-mechanical structure that incorporates the physical media of the bus through a series of connectors. The electro-mechanical structure that incorporates the physical media of the bus is called a bus backplane. Various standards have been developed which defined the physical features of the backplane and the bus protocols. These bus standards include VME, Futurebus, Multibus, Nubus. The use of such bus standards allows for end users to configure their own computer systems on a single bus backplane to be able to use a variety of modules designed by many different vendors.

L5: Entry 2 of 3 File: USPT Jun 16, 1992

US-PAT-NO: 5122691
DOCUMENT-IDENTIFIER: US 5122691 A

TITLE: Integrated backplane interconnection architecture

DATE-ISSUED: June 16, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Balakrishnan; Balu	Saratoga	CA	95070	

APPL-NO: 07/ 616580 [PALM]
DATE FILED: November 21, 1990

INT-CL: [05] H04Q 11/04, H04J 3/12, H04L 7/08, H04L 12/40

US-CL-ISSUED: 307/475; 370/58.2, 370/110.1, 370/85.9, 361/413
US-CL-CURRENT: 326/86; 326/101, 326/62, 326/90, 361/788, 370/364

FIELD-OF-SEARCH: 307/475, 361/413, 439/61, 439/62, 370/85.1, 370/85.5, 370/85.6, 370/85.7, 370/85.9, 370/85.15, 370/58.1, 370/58.2, 370/58.3, 370/108, 370/60.1, 370/60, 370/110.1

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4697858	October 1987	Balakrishnan	361/413 X
4875206	October 1989	Nichols et al.	370/85.15
4899333	February 1990	Roediger	370/60
4955020	September 1990	Stone et al.	370/85.9
5051982	September 1991	Brown et al.	370/58.2

ART-UNIT: 259

PRIMARY-EXAMINER: Westin; Edward P.

ASSISTANT-EXAMINER: Bertleson; David R.

ATTY-AGENT-FIRM: Weller; Douglas L.

ABSTRACT:

A backplane, provides a physical layer level interconnection between a plurality of modules. The backplane includes a physical layer inplementation of an interconnection topology incorporated within one or more integrated circuits called interconnect chips. Incorporated on the interconnect chips are interconnect drivers and interconnect receivers for the physical layer implementation of the interconnection topology. These interconnect drivers and interconnect receivers provide point-to-point links between the physical layer implementation of the interconnection topology and the plurality of modules. Each point-to-point link may include two separate point-to-point link lines, one for an interconnect driver and one for an interconnect receiver. For the bus interconnection topology, alternately, each point-to-point link may be tri-level, including only a single point-to-point link line. The interconnection topology may be, for example, a bus topology, a ring topology or a circuit switched topology.

39 Claims, 26 Drawing figures

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